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## A Study on the Stability of Contract-based Knowledge Alliance<sup>1</sup>

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**Abstract:** Contract-based knowledge alliance is based on contract, as a link to share knowledge resources, the flow of knowledge and innovation and complementary advantage of other organizations formed by contract or equity, risk-sharing network of organizations. Organization of bounded rationality, opportunism and the external environment of the organization's uncertainty led to the alliance itself has an income distribution mechanism of the instability, the design of effective, confidence-building mechanism and the formation of efficient information communication mechanisms is conducive to enhancing the stability of the Union.

**Key words:** Contract-based knowledge alliance, stability, knowledge income and distribution mechanisms, trust mechanisms, communication mechanisms

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### INTRODUCTION

21st century is the age of knowledge economy, the enterprise to gain competitive advantage in the fierce market competition and occupy the favorable ecological niche. You must learn quickly improve their innovation ability, the innovative ability of learning, so to learn from foreign and domestic excellent enterprise is a learning process to contribute to the formation of strategic knowledge alliance. Knowledge alliance refers to the enterprises or scientific research institutions to share knowledge resources and promote knowledge flow and innovation, through contracts with other institutions or equity form complementary advantages and risk-sharing network (Norman, 2002). Knowledge alliance is the era of knowledge economy to adapt to the increasingly competitive external environment and the rise of a new strategic organization mode, is more advanced forms of alliance development chain. It came from a coalition of knowledge view, is through the way of alliance between organizations, together to create knowledge and knowledge transfer, is the enterprise to adapt to global competition and environmental challenges of the knowledge economy and to make a strategic response (Cao, 2008). Knowledge alliance in terms of knowledge innovation and knowledge sharing, sharing advantages, flexible way, economic cost, high efficiency, thus become organizational members to improve the competitiveness of an important system of choice, however, due to the effect of various factors, existing in the knowledge alliance cooperation risk and instability. A lot of practice investigation and study, found that alliance instability or collapse up to 70% (Bleeke and Ernst, 1993; Dacin *et al.*, 1997). Therefore, the study of knowledge alliance stability has become an important problem of academia right now.

Some scholars focus on the union caused from is not to analyze the influence factors of stability. Using transaction cost theory, game theory, resource dependence theory is the most typical and universal. Most study adopting game theory will be the establishment of the alliance body as a process of repeated game. Implications of members in the repeated game many times cooperation intention and long term alliance contract can produce effect of cooperation. While short-term union contracts will have a competition effect, lead to opportunistic behavior and the alliance instability (Parkhe, 1993; Hu and Liu, 2009). Based on the above analysis, the author thinks that, using the contract theory to analyze the problems of the stability of knowledge alliance and should be able to draw useful conclusions.

### CONTRACT KNOWLEDGE ALLIANCE

From the perspective of industrial organization and present a multiple relationship between groups, such as pure and looser trade relations; Through the franchise and license management form of contractual relationship; Through the joint and cooperation agreements in the contractual relationship between the form of; Through mergers and acquisitions to form a close integration of the relationship between organizations. These relationships are the continuum between participants of the market and knowledge, as shown in Fig. 1. The contract relationship between the bodies of knowledge is the contractual knowledge alliance referred in this study. It refers to the knowledge body through co-operation based on common interests between knowledge value-added service, on the basis of equality, through a variety of formal contract and form complementary advantages, benefit-sharing, risk-sharing loose cooperation development organization

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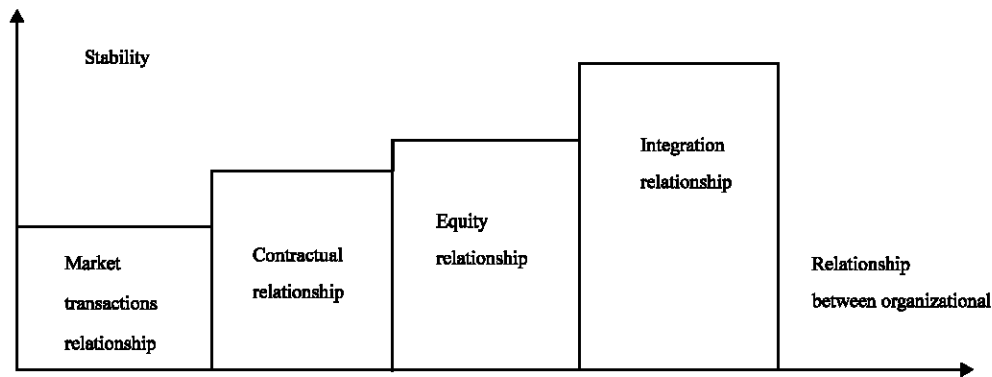


Fig. 1: Relationship between organizational stability

knowledge. Because does not involve equity participation, contractual knowledge alliance stability more emphasis on external coordination and tacit understanding between subject knowledge, nature as a result, more have a union.

**Contractual characteristic of the knowledge alliance:**

- An alliance between the body of knowledge in a certain period of time to keep a certain level of interdependence, but does not lose its own flexibility
- Based on their own knowledge resources integration, improve the whole competitiveness of knowledge alliance, to carry out the individual knowledge between the main bodies can't bear alone or independent intellectual development activities to undertake the cost is too high
- Based on the knowledge alliance knowledge resources effectively within the organization, implementation of knowledge resources sharing, improve the use efficiency of knowledge resources, give full play to the economic multiplier effect of the knowledge alliance

By contract, of course, knowledge alliance with these advantages, at the same time, also exposed itself to knowledge alliance - the largest lack of lack of stability, as shown in Fig. 1, which often makes the most of the knowledge alliance reactive and fruit.

**By contract knowledge alliance of stability of logical reasoning :** Williamson (1985) according to the character of the transaction, the transaction coordination mode is divided into four kinds:

- **"The market regulation" type:** This is trading terms through complete several "bargaining", referred to as the classical market contracting

- **"Tripartite regulation" type:** That both parties agreed a common recognition of a third party and the default camera decision-making rights by third parties
- **"Bilateral regulation" type:** Trading in cooperation between the two sides remain independent status at the same time, but each other appear certain to maintain the long-term cooperation mechanism
- **"Unified regulation" type:** Realize the integration.Trade both sides realize the highly integration, form a new group

According to Williamson's theory, contractual ways of knowledge alliance apparently similar to "bilateral regulation", it can be understood as a communicative activity between two or more knowledge of an incomplete contract. In this contract, the control of the knowledge of every subject are bounded rationality, Due to participate in the body of knowledge in the league to keep the position of independent, therefore, independent thinking, every subject knowledge, in turn, will not converge automatically on the interests and actions. When there is an unforeseen condition, participants were first formed the knowledge alliance contract arrangement will show great uncertainty, threaten and destroy the alliance stability.

**BY CONTRACT KNOWLEDGE ALLIANCE OF STABILITY ANALYSIS OF THEINFLUENCING FACTORS**

By combing the literature, knowledge alliance of stability influence factors can be summarized as the following aspects:

- **League goals is inconsistent:** Knowledge alliance's stability is to establish partnership for a long time, so the cooperation between various knowledge subject

long-term goals should be highly consistent, But reality form a knowledge alliance often are of current interest is consistent, is not the same values. Time is long, the differences will be worse, lead to the disintegration of alliance

- **Alliance partner selection is incorrect:** Alliance is unstable or failed, largely because the alliance partner selection is wrong, Coalition partners is proper alliance stability is the basic conditions
- **Culture and strategy differences between alliance members:** If you select the appropriate partners can avoid incompatible faults and generate competitive advantage and across the enterprise, across regional and transnational alliance between because each other's culture, infrastructure, economic development level, the different government policies, increase more league situation between complex (Slocum, Jr. and Lei, 1993). Cultural differences and conflicts is a union of a very prominent problem
- **Opportunism tendency between alliance members:** In the form in the process of knowledge alliance, alliance member's effort and input it is difficult to measure, Therefore prone to hitchhike or lazy in cooperation and theft now Angle, susceptible to opportunistic speculation (Lin and Liu, 2007)
- **Union contribution assessment and lack of compensation mechanism:** In the process of knowledge alliance operation, the transfer and exchange of alliance between intangible assets such as knowledge, technology and capability have the characteristic of fuzziness and concealment, which would be hard to scientific evaluate each member's contribution. Often in the benefit sharing between each member will be on his own, into horizontal comparison, which tends to be the main cause of contradiction between alliance members
- **Dynamic changes of the external environment interferes with the stability of alliance:** Due to the dynamic changes of the external environment, members of their own conditions change, This change may is good for one party, for the other party is weak, This creates an imbalance of power between alliance members, That imbalance forces or let the union interest to break up, or make the alliance members divided even broken relationship
- **Information asymmetry cause alliance management defect in management mechanism:** Information asymmetry between union members affects the effective operation of alliance management system. This contract mechanism is, in fact, a kind of incomplete contract mechanism. It is only incentive and threatening, with weak enforcement of members

Through the above analysis, the main factors influencing the contractual knowledge alliance stability can be summarized into three categories. Bounded rationality and uncertainty or complexity is the first factor. Without considering the uncertainty, alliance of behavior is rational. Opportunism and bounded rationality between alliance members is the second factor, which influences the stability of alliance. Bounded rationality between alliance members will lead to opportunistic behavior. Information asymmetry is the third type of factors affecting the stability of alliance, It is the result of the combination of uncertainty and opportunism and information asymmetry will ultimately lead to members trading co., LTD., adding to the alliance of stability.

#### **BY CONTRACT KNOWLEDGE ALLIANCE STABILITY ENHANCEMENT MECHANISM DESIGN**

In clarifying the factors affecting the stability of contractual knowledge alliance, the author in the design by contract knowledge alliance stability enhancement mechanism, must consider how to abate focus on these three factors affect its stability.

**Knowledge alliance income distribution mechanism design:** By contract knowledge alliance and the opportunism behavior, is rooted in its intended opportunistic returns greater than its cooperation with members of the normal profits, therefore, the key to solve this problem is to design a desirable benefit distribution mechanism, to ensure that members of the costs and benefits is symmetrical, reduce the opportunism urge. The author believes that the process is actually a game between alliance members, So use game theory to design a benefit-sharing, risk-sharing benefits sharing mode, The alliance members according to their own's contribution to the alliance in accordance with the predetermined ratio from the sharing of knowledge to the a. From the principle of the contractual interest allocation mechanism of knowledge alliance accord should follow the following six basic assumptions:

- **Hypothesis 1:** Contract knowledge alliance revenue is equal to the total income of union members that shared by alliance members
- **Hypothesis 2:** Alliance member's income and the risk symmetry
- **Hypothesis 3:** The income of members is symmetric with knowledge input
- **Hypothesis 4:** The normal return can be obtained from a transaction
- **Hypothesis 5:** All members are rational people and them all have opportunistic behavior

- Hypothesis 6:** In order to simplify the model, this article assumes that knowledge alliance is only composed of two members  $x_1$  and  $x_2$ . Among them,  $x_1$  stands for knowledge alliance leader,  $x_2$  for knowledge alliance member. Knowledge creation cost of Alliance members doing consists of fixed cost and variable cost. The fixed cost refers to the sum of the unrecoverable sunk costs that the union members have input in the process of knowledge creation. The variable cost refers to the cost is positive linear correlation to knowledge input of alliance members

Based on the above assumption, it is not difficult to draw: The action strategy starting from the knowledge alliance benefit maximization is cooperation, while the action strategy starting from the individual benefit maximization is non-cooperation. The game relation is expressed by Table 1 as follows:

This study considers the fixed cost and variable cost of game both sides. In the process of the game, operation mechanism of knowledge alliance can be summarized as: (1) The members started from the overall interests (cooperation), shared knowledge creation and determine knowledge income distribution coefficient that both sides has recognized, this step as a cooperative game; (2) One knowledge income distribution coefficient is determined, union members consider to maximize (cooperation) from their own interests and determine the respective inputs to the knowledge alliance, this step is a non-cooperative game. At this point, the key to the problem is transformed into how to determine the optimal distribution coefficient and alliance members how to make their own optimal action choice under the knowledge distribution contract.

So, that  $a_1$  and  $a_2$ , respectively mean knowledge alliance chief and leaguers conduct to the knowledge input levels of knowledge creation;  $b_1$  and  $b_2$ , respectively mean  $a_1$  and  $a_2$  make a contribution to knowledge gain coefficient;  $\delta_1$  and  $\delta_2$ , respectively mean the variable cost coefficient of  $x_1$  and  $x_2$ ;  $c_{x1}$  and  $c_{x2}$ , respectively denote the fixed costs of  $x_1$  and  $x_2$ ;  $c_{x1}$  and  $c_{x2}$ , respectively denote the variable costs of  $x_1$  and  $x_2$ ;  $R(a_1x_1, a_2x_2)$  is knowledge gain of the knowledge alliance; The proportion of income of  $x_1$  and  $x_2$  in the knowledge gains are  $\mu$  and  $1-\mu$ ; According to the linear relationship  $D+(1-\mu)R$ , the union chief of knowledge pays compensation to federate. Among them,  $D$  is fixed remuneration, which the chief paid to federate, with the initial investment of fixed costs related to and the input level of knowledge having nothing to do. The reason to design the pay compensation in accordance with the linear relationship is to ensure that the fixed costs and knowledge input levels that each federate paid are to

get payment and are positively related to the level of effort;  $TR$  is the net gain of knowledge result of the knowledge alliance.

$TR_{x1}$  and  $TR_{x2}$ , respectively denote the net income  $x_1$  and  $x_2$  share. Wherein,  $a_1, a_2, \delta_1, \delta_2, c_{x1}, c_{x2}$  are all greater than 0 and are constants. If  $0 \leq \mu \leq 1$ , we have:

$$TR = R(a_1x_1 + a_2x_2) - (c_{x1} + c_{x1}) - (c_{x2} + c_{x2}) \quad (1)$$

$$TR_{x1} = \mu R(a_1x_1 + a_2x_2) - (c_{x1} + c_{x1}) - D \quad (2)$$

$$TR_{x2} = D + (1 - \mu)R(a_1x_1 + a_2x_2) - (c_{x2} + c_{x2}) \quad (3)$$

Without loss of generality, we make the following further assumptions, knowledge into variable costs and benefits that knowledge chief and federate paid are quadratic function of the level of effort and include:

$$c_{x1} = c_{10} + 0.5(\delta_1x_1)^2 \quad (4)$$

$$c_{x2} = c_{20} + 0.5(\delta_2x_2)^2 \quad (5)$$

$$\left[ \begin{aligned} R(a_1x_1, a_2x_2) &= 0.5(\delta_1x_1 + \delta_2x_2)^2 \\ &+ (\delta_1x_1 + \delta_2x_2) + R_0 \end{aligned} \right] \quad (6)$$

Among them,  $c_{10}, c_{20}, R_0$  are constants;  $a_1 < \delta_1, a_2 < \delta_2$ , which is to ensure the convergence of knowledge alliance revenue function knowledge constraints, the benefits and cost functions into (1), (2), (3), there are:

$$\begin{aligned} TR &= 0.5(a_1x_1 + a_2x_2)^2 + (a_1x_1 + a_2x_2) + \\ &R_0 - \{c_{x1} + c_{10} + 0.5(\delta_1x_1)^2\} \\ &- \{c_{x2} + c_{20} + 0.5(\delta_2x_2)^2\} \end{aligned} \quad (7)$$

$$\begin{aligned} TR_{x1} &= \mu\{0.5(a_1x_1 + a_2x_2)^2 + \\ &(a_1x_1 + a_2x_2) + R_0\} - \{c_{x1} + c_{10} + \\ &0.5(\delta_1x_1)^2\} - D \end{aligned} \quad (8)$$

$$\begin{aligned} TR_{x2} &= D + (1 - \mu)\{0.5(a_1x_1 + a_2x_2)^2 \\ &+ (a_1x_1 + a_2x_2) + R_0\} - \{c_{x2} + c_{20} + \\ &0.5(\delta_2x_2)^2\} \end{aligned} \quad (9)$$

Using backward induction, considering the game between the chief and the federate as non-cooperative game, assuming that under the condition of income distribution proportion determined, alliance members are derived how to select the action strategies.

According to Eq. 8 and 9, respectively for  $x_1$  and  $x_2$  seeking the first order partial derivatives can obtain the effort level  $x_{10}$  and  $x_{20}$ , to pursue largest self-interest of each federate to achieve the Nash equilibrium, there are:

$$\frac{\partial TR_{x_1}}{\partial x_1} = \mu a_1 (a_1 x_1 + a_2 x_2 + 1) - \delta_1^2 x_1 = 0 \quad (10)$$

$$\frac{\partial TR_{x_2}}{\partial x_2} = (1 - \mu) a_2 (a_1 x_1 + a_2 x_2 + 1) - \delta_2^2 x_2 = 0 \quad (11)$$

Associated vertical Eq. 10 and 11 when the equilibrium is obtained  $x_{10}$  and  $x_{20}$ :

$$x_{10} = \frac{\mu a_1 \delta_2^2}{\delta_1^2 \delta_2^2 - \mu a_1^2 \delta_2^2 - (1 - \mu) a_2^2 \delta_1^2} \quad (12)$$

$$x_{20} = \frac{(1 - \mu) a_2 \delta_1^2}{\delta_1^2 \delta_2^2 - \mu a_1^2 \delta_2^2 - (1 - \mu) a_2^2 \delta_1^2} \quad (13)$$

Associated vertical Eq. 12 and 13 can be obtained:

$$\frac{x_{10}}{x_{20}} = \frac{\mu}{1 - \mu} \cdot \frac{a_1}{a_2} \cdot \frac{\delta_2^2}{\delta_1^2} \quad (14)$$

By the Eq. 14 can be introduced: Intellectual efforts level is proportional to its own partition coefficient and its contribution coefficient while that is inversely proportional to the square of the coefficient of the variable cost when knowledge alliance members pursue their best interests. This conclusion is corroborated that this hypothesis and contract design are conducive to the success and benign operation of the entire league.

On the basis of this conclusion, when the knowledge alliance chief takes a cooperative game with Leaguers, how to determine the optimal partition coefficient should be taken into further consideration. The answer can be found through determining the optimal coefficient when TR as knowledge net earnings of the knowledge alliance is biggest. TR for  $\mu$  in the Eq. 1 seeking the first order partial derivatives can be obtained:

$$\frac{\partial TR}{\partial \mu} = \frac{\partial TR}{\partial x_{10}} \cdot \frac{\partial x_{10}}{\partial \mu} + \frac{\partial TR}{\partial x_{20}} \cdot \frac{\partial x_{20}}{\partial \mu} \quad (15)$$

In the Eq. 15,  $\partial TR/\partial x_{10}$  and  $\partial TR/\partial x_{20}$  can be obtained through the Eq. 7 seeking the first order partial derivatives.  $\partial x_{10}/\mu$  and  $\partial x_{20}/\mu$  can be obtained through the associated vertical (12) and (13). To make Eq. 15 be equal to 0 can be obtained:

$$\mu_0 = \frac{a_1^2 (\delta_2^2 - a_2^2)}{a_1^2 (\delta_2^2 - a_2^2) + a_2^2 (\delta_1^2 - a_1^2)} \quad (16)$$

$$1 - \mu_0 = \frac{a_2^2 (\delta_1^2 - a_1^2)}{a_1^2 (\delta_2^2 - a_2^2) + a_2^2 (\delta_1^2 - a_1^2)} \quad (17)$$

$\mu_0$  and  $1 - \mu_0$  are the optimal partition coefficient of knowledge alliance members. Overall net benefits of the knowledge alliance achieve maximize when  $x_1$  and  $x_2$  share knowledge benefits, respectively according to  $\mu_0$  and  $1 - \mu_0$  distribution ratio.

**Design of trust mechanism by contract knowledge alliance:**

Because there are many uncertainties and complexities, the greater uncertainty about future events, the more trust the knowledge alliance members need each other. Trust can ensure that members use mutually acceptable behavior to take corresponding reaction to the unknown environment under the limited rational range. An effective trust mechanism can record fairly trade behavior between the chief and members to provide valuable reference when other members make decisions. The author thinks that, alliance trust mechanism can be designed according to the following ideas.

**Choose trust evaluation factors and prepare for evaluation:**

The trust of knowledge alliance essentially for the trust of a member, is based on a series of elements of the comprehensive evaluation and concentrated reflection of its past, present, future and so on, which is a kind of prediction of its future behavior based on experience. In contract knowledge alliance, the trust evaluation to a member mainly involves in four factors such as one's reputation, practice, degree of interdependence and time length of cooperation. The weights of these four factors can be set, respectively to  $\lambda_1, \lambda_2, \lambda_3, \lambda_4$  and  $\lambda_1 + \lambda_2 + \lambda_3 + \lambda_4 = 1$ . Evaluation leaguer gives the leaguer that is evaluated a score, according to these factors, scoring criteria as follows: very good (5 points), good (4 points), general (3 points), bad (2 points), very poor (1 min). The score of each factor is denoted respectively as  $d_1, d_2, d_3, d_4$ , then the evaluation score is:

$$Z = \lambda_1 d_1 + \lambda_2 d_2 + \lambda_3 d_3 + \lambda_4 d_4 \quad (18)$$

**Establish trust evaluation model and implement evaluation:**

Assume that contract knowledge alliance consists of n leaguers, in which the first j leaguer evaluates the first i leaguer at the end of the first m times transactions, there are:

$$Z_{ij}^i = \lambda_1 d_{ij1}^i + \lambda_2 d_{ij2}^i + \lambda_3 d_{ij3}^i + \lambda_4 d_{ij4}^i \quad (19)$$

After normalization treatment, that can be obtained:

$$q_{ij}^i = \frac{1}{1 + e^{-z_{ij}^i}} - \frac{1}{1 + e^{-3}} \quad (20)$$

Assume that the trust value is  $K_t^i$ ,  $K_t^i \in (1-, 1)$ , when the first I leaguer of contract knowledge alliance is involving in the first t times transactions. For new member, his trust value is 0 and each member has only one trust value. After the transactions, the trust value of the first i member turns into:

$$K_{t+1}^i = f(k_{t,i}^i)$$

There are:

$$f(k_{t,i}^i) = \frac{1}{1 + e^{-k_{t,i}^i}} \cdot \frac{1}{1 + e^3} \quad (21)$$

$$k_{t+1}^i = K_t^i + \sum_{j \neq i} \frac{q_{(t+1),j}^i}{1 + e^{-pK_{(t+1),j}^i}} \quad (22)$$

Among them,  $K_{t+1}^i$  is the changed trust value after the first i leaguer involved in the first t times transactions,  $f(k_{t,i}^i)$  for the regularization operator,  $k_{(t+1),j}$  as the trust value after the first i leaguer involved in the first t times transactions, p as a given constant and the greater p, the more  $k_{(t+1),j}$  impacts on  $k_{t+1}^i$ .

The above trust mechanism comprehensively considered all relevant factors affecting trust and considered the trust value of the evaluation member is impacted on the trust of the evaluation member, which can reflect accurately the trust differences between the members objectively and also be able to visually reflect the trust value of two Leaguers.

**Design of communication mechanism by contract knowledge alliance:** In contractual knowledge alliance, asymmetric information problems result from the combination of the uncertainty and limitations of the opportunism behavior, trading partners and many complex factors always exist. Asymmetric information between knowledge alliance members will lead to the divergence of its technology, resource allocation and so on in the process of cooperation, which not only reduces overall competitive power of the knowledge alliance but also easily leads to knowledge alliance instability directly due to the poor economic benefits. To effectively prevent from a threat to knowledge alliance stability because of

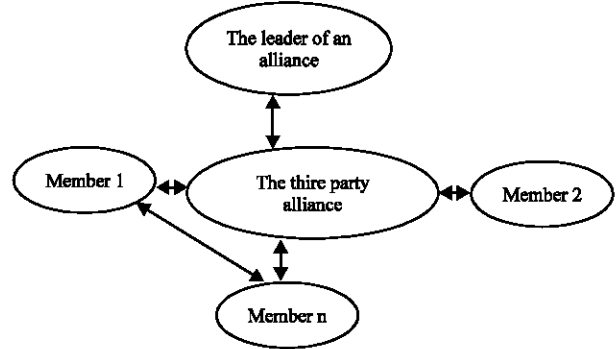


Fig. 2: By control information communication form of knowledge

information asymmetry, it is very necessary to build a third party alliance coordination commission which the chief and members all trust to solve the problem of information communication of knowledge alliance. As shown in Fig. 2.

## CONCLUSION

Briefly based on the foregoing analysis, this study draws the following conclusions:

- It can be seen from the literature review that the studies on currently the stability of contract knowledge alliance are very weak, so it is necessary to carry out research in this area
- The factors affecting the stability of contractual knowledge alliance are very multifarious and the keys enhance its stability are fairness and balance of alliance members benefit mechanism, good trust mechanism and communication mechanism
- The overall strength between knowledge alliance members should be equal, which is objectively beneficial to the stability of alliance and the maintenance of alliance mechanism

To this end, we believe that the contract knowledge alliance management should be made from the following aspects:

- A fair management mechanism of knowledge alliance should be built to realize the relatively fair between the alliance members

The stability of the knowledge alliance consists largely in effective management mechanism. A chief of knowledge alliance, therefore, should publicly disclose

alliance information and transfer some of their own interests moderately to set a good example for the members:

- The enterprise should pay attention to the system construction of knowledge network

Knowledge has some characteristics, such as organization, exogeneity, Inertia, variability and logical concordance (He and Li, 2008). Knowledge is the gene fragment to connect one by one. So, knowledge alliance members based mainly on knowledge grafting have the whole memory, which makes the knowledge alliance members and knowledge experience with which existing knowledge nodes successfully integrated can be memorized by both sides. The memory can make the netting of both sides process more smoothly in the next time (Ren, 2011):

- The management of knowledge alliance and knowledge should be strengthened, because knowledge resource is the key of the alliance operation

Knowledge management of the knowledge alliance is mainly to build knowledge base with common knowledge between alliances for common use of alliance members to achieve the purpose of maximization of knowledge utility (She and Guo, 2011).

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